Kronecker-δ Terms in the Peripheral Model
and Dispersion Relations*

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It is pointed out that Kronecker-δ terms do not arise if one calculates peripheral contributions from unsubtracted dispersion relations.

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In single particle exchange models calculated by Feynman techniques, one encounters invariant amplitudes of the form

$$M(s,t) = \frac{P(s,t)}{m^2 - t} \tag{1}$$

where $P(s,t)$ is a polynomial in t, the t dependence of which arises from spin effects at the vertices. Equation (1) may be rewritten as

$$M(s,t) = \frac{P(s,m^2)}{m^2 - t} + R(s,t) \tag{2}$$

where, again, $R(s,t)$ is a polynomial in t. The presence of R produces certain unwanted effects[1], such as "exceptional" terms proportional to $\delta_{J,J'}$ in low partial-wave amplitudes, which terms violate unitarity. These Kronecker-δ terms were the subject of a recent paper by Williams[2], who suggests a motivation for omitting such terms in one-particle exchange calculations with or without absorption. It is pointed out, in particular, that form factors diminish the effect of these terms.

It is the purpose of this note to point out that such terms should not necessarily arise. If one calculates the invariant amplitudes by fixed-s unsubtracted dispersion relations[3], one obtains amplitudes $M'(s,t)$ of the form

$$M'(s,t) = \int \frac{\delta(m^2 - t')\, P(s,t')\, dt'}{t' - t} = \frac{P(s,m^2)}{m^2 - t} \tag{3}$$

without the unwanted remainder. Indeed, such terms as $R(s,t)$ would have to be absent for the dispersion relations to be valid.

FOOTNOTES

[1] L. Durand, III, and Y. T. Chiu, Phys. Rev. 137, B1530 (1965).

[2] P. K. Williams, Phys. Rev. 181, 1963 (1969).

[3] See, *e.g.*, the calculation of the K^*-exchange amplitude in $\pi^- p \rightarrow \Lambda K^0$: J. E. Rush, Jr., Phys. Rev. 173, 1776 (1968).